

Boston Greenhouse Gas Inventories (ii)

1. FY2006 City of Boston Municipal GHG Emissions
2. Revised FY2005 City of Boston Municipal GHG Emissions
3. Revised FY2000 City of Boston Municipal GHG Emissions
4. Notes

FY2006 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Original 12/17/2008

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	37,532		354	14,436	24,770		77,092	37%
Center for Youth and Families	3,024				1,682		4,706	2%
Emergency Medical Services	248				145		393	0%
Fire	3,146	239	919	2,240	2,420		8,964	4%
Graphic Arts	197				89		286	0%
Library	918	239			8,797	3,991	13,945	7%
Neighborhood Development					52		52	0%
Parks and Recreation	490	226	146	530	1,620		3,012	1%
Police	2,396	476	9,269	2	5,455		17,598	9%
Property & Construction Mgmt	589	457			8,265	1,430	10,741	5%
Public Works	2,061	156	5,673	2,006	1,696		11,592	6%
Public Works Streetlights	5,116				31,621		36,737	18%
Transportation	177	92			287		556	0%
Public Health Commission	6,296	5,663			3,748		15,707	8%
Water and Sewer Commission	687	53	843	721	2,546		4,850	2%

ADJUSTMENTS and TOTALS

Scope 1 total	107,617
Scope 1 adjustments (note 4a)	31
Scope 1 adjusted total	107,586
Scope 2 total	98,614
Scope 2 adjustments (note 4b)	7,264
Scope 2 adjusted total	91,350

GHGs by Sector*	eCO ₂	%
Buildings	132,355	64%
Transportation	37,139	18%
Streetlights	36,737	18%

*unadjusted

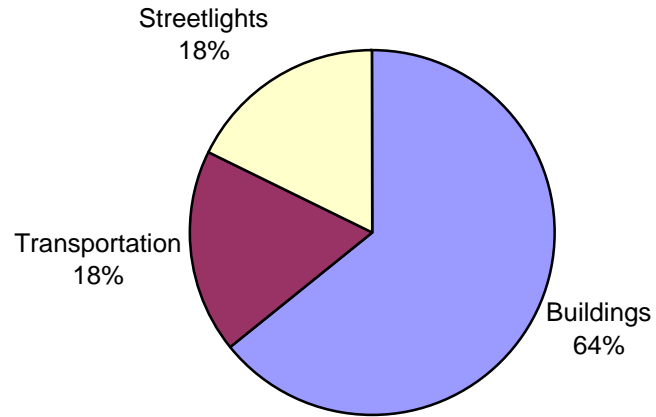
GHGs by Fuel*	eCO ₂	%
Electricity	93,193	45%
Natural gas	62,877	30%
Diesel	19,935	10%
Gasoline	17,204	8%
Light fuel oil	7,294	4%
Steam	5,421	3%
Propane	307	0%

*unadjusted

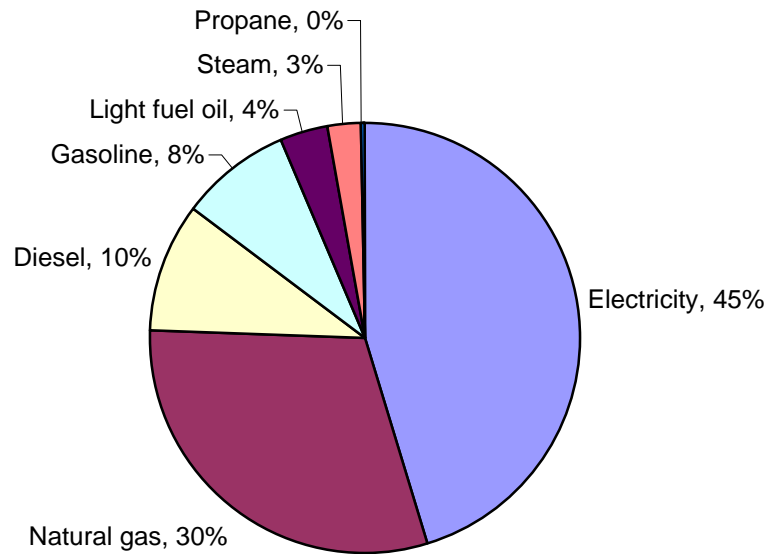
Scope 1+2 ADJUSTED TOTAL 198,936

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Redevelopment Authority	1,648	77			146		1,871
MWRA (Boston share)	895	9,261	359	68	25,396		35,979

FY2006 Municipal GHGs by Sector



FY2006 Municipal GHGs by Fuel



FY2005 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Revised 12/17/2008

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	38,572		366	14,416	30,825		84,179	40%
Center for Youth and Families	3,031				1,530		4,561	2%
Emergency Medical Services	258				169		427	0%
Fire	2,715	603	920	2,111	2,443		8,792	4%
Graphic Arts	261				85		346	0%
Library	958	202			8,187	3,776	13,123	6%
Neighborhood Development					127		127	0%
Parks and Recreation	644	220	226	546	1,545		3,181	2%
Police	2,957	610	9,004	1	5,061		17,633	8%
Property Management	523	511			7,986	1,875	10,895	5%
Public Works	2,515	158	5,279	2,356	1,703		12,011	6%
Public Works Streetlights	5,116				32,149		37,265	18%
Transportation	228	45			345		618	0%
Public Health Commission	6,040	5,066			3,864		14,970	7%
Water and Sewer Commission	873	90			2,724		3,687	2%

ADJUSTMENTS and TOTALS

Scope 1 total	107,421
Scope 1 adjustments	0
Scope 1 adjusted total	107,421
Scope 2 total	104,394
Scope 2 adjustments (note 4b)	1,734
Scope 2 adjusted total	102,660

GHGs by Sector*	eCO ₂	%
Buildings	139,325	66%
Transportation	35,225	17%
Streetlights	37,265	18%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	98,743	47%
Natural gas	64,691	31%
Diesel	19,430	9%
Gasoline	15,795	7%
Light fuel oil	7,198	3%
Steam	5,651	3%
Propane	307	0%

*unadjusted

Scope 1+2 ADJUSTED TOTAL 210,081

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	47,097	6,705	420	22	31,625	696	86,565
Redevelopment Authority	1,980	64	850	783	156		3,833
MWRA (Boston share)	849	9,227	378	245	24,595		35,294

FY2000 City of Boston Municipal GHG Emissions - in Equivalent CO₂ tons

Revised 12/17/08

SCOPE 1 AND 2	SCOPE 1				SCOPE 2		Subtotal	%
	Nat. Gas	Lt. Fuel Oil*	Gasoline	Diesel	Electricity	Steam		
Boston Public Schools	17,701	19,396	372	13,758	28,819	130	80,176	40%
Community Centers	3,087				1,257		4,344	2%
Emergency Medical Services			507				507	0%
Fire Department	2,906	1,423	1,221	2,076	2,360		9,986	5%
Graphic Arts Department	223				33		256	0%
Library Department	733	1,247			3,243	1,964	7,187	4%
Neighborhood Development	117				17		134	0%
Parking					37		37	0%
Parks & Recreation Dept.	384	548	911	500	1,510		3,853	2%
Police Department	2,177	786	9,556		3,627	305	16,451	8%
Property Management	411	580			4,924	1,881	7,796	4%
Public Works	295	200	5,517	3,228	1,158	3,356	13,754	7%
Public Works - Streetlights	5,116				29,395		34,511	17%
Transportation Department	204	53			3,056		3,313	2%
Public Health Commission	4,339	6,499			3,796		14,634	7%
Water and Sewer Commission	3,039				2,522		5,561	3%

*Includes 164 tons from propane for BPHC

ADJUSTMENTS and TOTALS

Scope 1 total	109,110
Scope 1 adjustments	0
Scope 1 adjusted total	109,110
Scope 2 total	93,390
Scope 2 adjustments	0
Scope 2 adjusted total	93,390
Scope 1+2 ADJUSTED TOTAL	202,500

GHGs by Sector*	eCO ₂	%
Buildings	130,343	64%
Transportation	37,646	19%
Streetlights	34,511	17%

*unadjusted

GHGs by Fuel*	eCO ₂	%
Electricity	85,754	42%
Natural gas	40,732	20%
Diesel	19,562	10%
Gasoline	18,084	9%
Light fuel oil	30,586	15%
Steam	7,636	4%
Propane	146	0%

*unadjusted

SCOPE 3	Nat. Gas	Lt. Fuel Oil	Gasoline	Diesel	Electricity	Steam	Subtotal
Boston Housing Authority	68,813	2,231			42,003		113,047
Redevelopment Authority	3,645				1,888		5,533
MWRA (Boston Share)					19,019		19,019

Notes on the FY2006 City of Boston Municipal Greenhouse Gas Inventory and Revised FY2000 and FY2005 Inventories

In his April 2007 [Executive Order Relative to Climate Action](#), Mayor Thomas Menino directed that the City report annually on its greenhouse gas (GHG) emissions. On January 10, 2008, the City released 2005 GHG emission inventories both for municipal operations and for the Boston community as a whole. This report contains the GHG inventory for municipal operations in fiscal year 2006 (FY06). It also contains revised municipal inventories for FY05 and FY00.

1. *For more information.* Boston GHG inventories are overseen by staff of the Boston [Air Pollution Control Commission](#) (APCC). Please direct any comments or questions about the inventories to Carl Spector, Executive Director, Air Pollution Control Commission, carl.spector@cityofboston.gov.
2. *New inventory protocol.* As discussed in the notes to the original 2005 report, the overall methodology for calculating GHG emissions relied on the [Clean Air and Climate Protection \(CACP\) software](#) developed by [ICLEI](#) and the [National Association of Clean Air Agencies](#) (the City of Boston is a member of both organizations). Over the past two years, ICLEI has worked with the California Air Resources Board, the California Climate Action Registry, and The Climate Registry to develop a new [Local Government Operation Protocol](#) for conducting inventories of GHG emissions. The protocol was adopted by ICLEI, the California Climate Action Registry Board, and the California Air Resources Board in 2008, and will be considered for formal adoption by The Climate Registry in 2009.

The City of Boston intends to conduct its inventory in accordance with the new protocol, although it may take several years to put all the necessary data collection and management systems into place. As a first step, the City is following the protocol's guidance concerning (a) direct and indirect emissions and (b) organizational and operational boundaries (see chapters 3 and 4 of the protocol).

a. Direct and indirect emissions. The protocol's division of direct (Scope 1) and indirect (Scope 2) emissions is straightforward. Direct emissions come from the burning of natural gas, fuel oil, gasoline, diesel fuel, and other fuels in the City's facilities, vehicles, and other equipment. Indirect emissions come from the burning of fuels in facilities owned and operated by others to produce electricity and steam that the City uses.

b. Organizational and operational boundaries. The new protocol's more involved questions surround Scope 3, "additional emission sources of potential policy relevance," which pertain to the decision of where to place the emissions of the independent and quasi-independent governmental authorities associated with the City of Boston, in particular, the [Boston Housing Authority](#), the [Massachusetts Water Resources Authority](#), the [Boston Public Health Commission](#), the [Boston Redevelopment Authority](#), and the [Boston Water and Sewer Commission](#), all of which were included in the original FY00 and FY05 inventories.

Concerning "autonomous departments," the protocol states:

It is often the case that autonomous departments like municipal utilities, ports and airports are managed by their own board of commissioners or executives. If this board is appointed by local government officials (e.g. appointed by the Mayor and confirmed by the City Council) and the local government officials have some level of oversight of the board (e.g. the local government can help guide policy decisions of the department, the actions of the Board can be reviewed and overturned by the City Council, etc.), then the local government is considered to have operational control over the department and should report the emissions associated with the municipal utility/port/airport as part of the local government's GHG inventory. (page 16)

This description applies to the Boston Public Health Commission and the Boston Water and Sewer Commission, whose members and directors are appointed by the mayor and which, therefore, are listed with other City departments. It does not apply to the Massachusetts Water Resources Authority (MWRA), where the City has three seats out of 11 on the MWRA's board of directors; MWRA emissions are listed in Scope 3.

c. Leased property. The new protocol states that a "lessor should not report emissions for assets leased under an operating lease if the lessor is using the operational control consolidation method." (page 19) Although the Boston Housing Authority (BHA) and the Boston Redevelopment Authority (BRA) come under the operational control of the City of Boston (see note 2.b), their emissions are listed under Scope 3, because the bulk of their emissions come from rental housing and leased industrial and commercial properties. As a practical matter, the BHA has a large number of programs to reduce energy use and greenhouse gas emissions at its properties.

3. *Revised electricity emission factor.* In the CACP software used to calculate emissions in the original FY2000 and 2005 inventories, the emission factor for electricity was based on the mix of generators overseen by the [Northeast Power Coordinating Council](#) (NPCC), which encompasses New England, New York, and Eastern Canada. The revised inventories and the new FY2006 inventory use an electricity emission factor based only on the NPCC's New England subregion, which corresponds to the area served by [ISO New England](#), the regional transmission organization, and excludes New York and Eastern Canada. The new electricity emission factor is about 18 percent higher, in particular because of the exclusion of considerable hydroelectric resources.

4. *Adjustments.* The Adjustments section of the inventory in the current inventories reflects the City's purchases of a biodiesel blend for its diesel vehicles and of Renewable Energy Credits for electricity purchases. Because there remains considerable disagreement about the proper calculations for the GHG implications of these energy sources, the adjustments are made outside of the Scope 1 and 2 calculations.

a. Biodiesel. In FY06, the City started buying B5, a mixture with 95 percent ultra-low-sulfur diesel and 5 percent biodiesel, for use in its diesel vehicles. In the Scope 1 calculation, all the diesel and biodiesel fuels are subject to the same emission factor of 0.0106 tons (2.12 lb) eCO₂ per gallon. The Scope 1 adjustment assumes that B100 (one hundred percent biodiesel), on the basis of a life-cycle calculation that includes the capture of atmospheric CO₂ during plant growth, has net emissions of only 0.00636 tons (1.27 lb) eCO₂ per gallon, a 40 percent reduction. (See Hill et al., "Environmental, economic, and energetic costs and benefits of biodiesel and ethanol biofuels," <http://www.pnas.org/content/103/30/11206>, 2006). In FY06, the City purchased the equivalent of 7,368 gallons of B100.

b. Renewable Energy Credits (RECs). RECs represent the generation of electricity from renewable energy sources such as wind and biomass. The City started buying RECs in FY05. In FY05 and FY06, these RECs came from Midwestern wind farms and Maine biomass plants and hydropower facilities. The Scope

2 adjustments assume that these sources of electricity have zero GHG emissions and that the appropriate adjustment per megawatt-hour (MWh) is the same as the electricity emission factor (see note 2). In FY05, the City purchased 3,787 MWh of RECs; in FY06, 15,860 MWh.

5. *Other FY05 revisions.* There are changes to the light fuel oil, gasoline, and diesel numbers to correct the allocation of deliveries by fiscal year. There are also small changes to the steam numbers to correct transcription errors. For the revision to the emissions from streetlights, see below.

6. *Data sources—City Hall departments.* Data on electricity and natural gas purchases by department come from the computerized Major Vendor System maintained by the Office of Budget Management. The Major Vendor System compiles monthly bills submitted by the City's electricity and natural gas suppliers. Data on gasoline, diesel, and fuel oil, and steam come from the Purchasing Department's list of invoices received for deliveries. Trigen Energy supplied the data on the City's steam consumption. The GHGs were allocated to fiscal year by the data of delivery; no attempt was made to determine when fuel was actually used. The annual inventories include some changes in department names and some consolidation of accounts. The municipal inventories do not include GHGs associated with official airplane travel nor with employee commuting.

7. *Data sources—authorities and commissions.* The five authorities and commissions maintain their own accounts for energy use. They transmitted their annual energy purchases to the APCC, which performed the GHG calculations.

8. *Streetlights.* Most of the City's natural gas streetlights and many of the electric streetlights are unmetered. The bills that the City receives for energy use are based on calculations by the utilities regarding size of pipe, number of hours of darkness, and so on. The GHG emissions for the gas streetlights are based on an average use of 69,000 therms per month.

9. *Boston Housing Authority.* The BHA's FY06 energy and emission data were not available as of the release date of the FY06 inventory. We hope to include them in later revisions.

10. *MWRA allocation.* The Massachusetts Water Resources Authority provides water and sewer services to 2.5 million people and more than 5,500 businesses in 61 communities in eastern and central Massachusetts. Based on measurements of actual flows, the MWRA allocated to Boston 11.8 percent in FY05 and 12.6 percent in FY06 of the energy associated with the water supply system, and, of the energy associated with the sewer system, 20.1 percent in FY05 and 19.3 percent in FY06.

11. *Verification.* The City of Boston municipal inventory has not received third-party verification. In general, existing verification frameworks require facility-specific data by calendar year. The City intends to develop the detail of its inventory to this level in the next several years and then obtain verification.

12. *FY05 v. FY06.* Adjusted total GHG emissions fell about 11,000 tons from FY05 to FY06. Two categories accounted for this change: emissions from Boston Public School operations came down over 6,000 tons, and adjustments for biodiesel and RECS increased by over 5,500 tons. Several departments had slight increases, and, in a few cases, energy data not available for FY05 was available for FY06. FY06 had fewer heating degree days than FY05 (5,329 vs. 5,889), but more cooling degree days (890 vs. 683).

December 18, 2008